The Cycle of INSANITY

The REAL STORY of WATER

Know Your H20 - Cycle of Insanity[1]: The Real Story of Water

FINAL DRAFT - 10/17/2009

[1] Our use of the term "Cycle of Insanity" is meant to characterize two interrelated problems with some isolated water management plans – primarily those inclusive of ocean desalination as we see n more and more States. First, it is arguably unsound economic and environmental policy ("insanity") to discharge partially treated wastewater to the ocean, only to then pump it back out of the ocean to remove the salts. This process wastes water and the energy spent to treat the water before discharging it. Using that partially treated wastewater as a "source water" for desalination (recycled water) would dramatically reduce impacts on marine life and utilize the energy already embedded in the treatment process.
Secondly, water agencies are drafting "Climate Change Adaptation Plans" for our water supply management -- given threats to predictable early snowmelt, prolonged droughts, seawater intrusion of surface and groundwater supplies, etc. It is unsound policy to adapt to these threats with a "new" source that is more energy intensive than the current sources. These plans to address climate change threats arguably exacerbate the threat they are meant to resolve – that is, reducing embedded energy in a holistic water management reform.

Cycle of Insanity: the Real Story of the Water Cycle

Introduction

SCENE 1

In elementary school, we learned about the water cycle, where water from the ocean evaporates to form clouds …

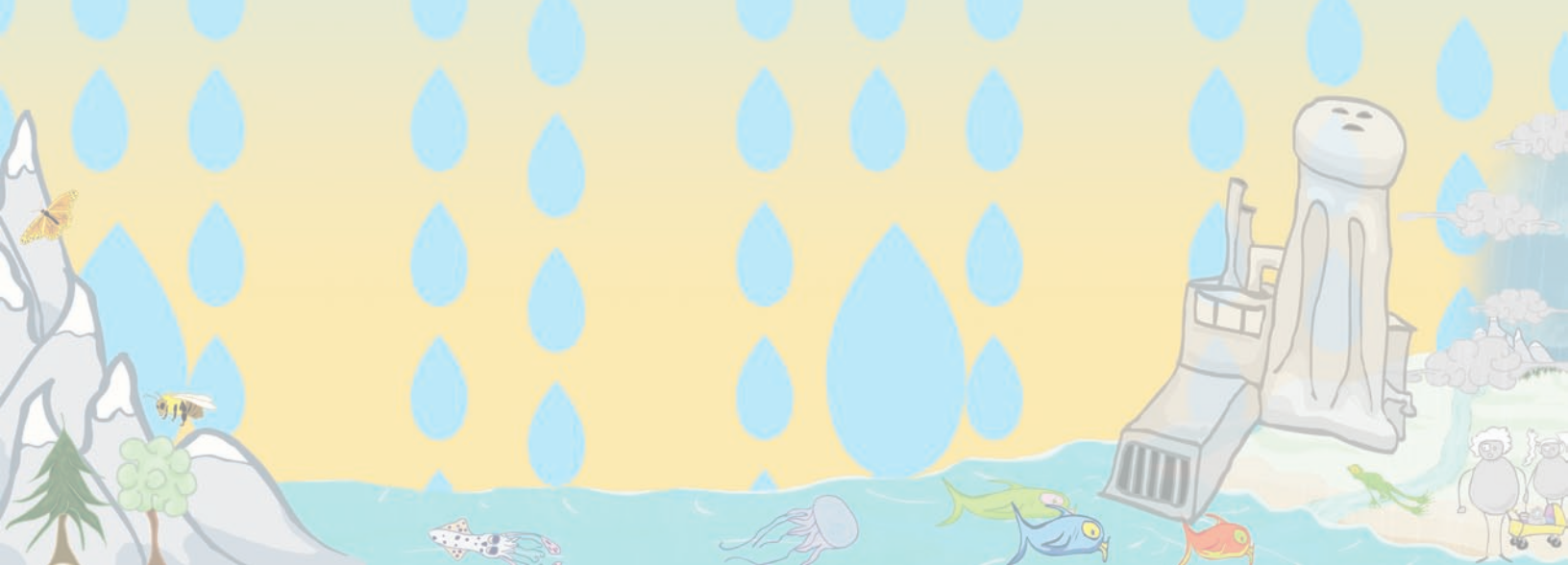
…that move over land, and drop fresh water as rain or snow. This *precipitation* soaks into the land and is stored underground …

…or flows into rivers that ultimately return to the ocean.

Rivers are the circulatory system of our planet and provide vital habitat to fish and aquatic life,

…and move nutrients and sand downstream to replenish wetlands and beaches at the river's mouth.

But you probably don't know the entire story.



SCENE 2

Before it gets to your home, water often travels hundreds, or sometimes thousands of miles through canals and pipes from far away mountains and rivers.

And when we're done using it, the water enters the ocean, polluted as a result of our wasteful water systems.

Wanna learn the real story of water?

Chapter 1: The History of Water

SCENE 3

All life depends on water. Civilizations grew on the banks of rivers. People developed agriculture and learned to irrigate the land, even in areas with limited rainfall[2].

Over time, more water was needed to provide for the increasing population …

…as many more cities and towns developed.

These days most of our rivers are dammed and diverted for human needs[3], often reducing downstream flows to not much more than a trickle.

Under natural conditions, rainfall soaks into the ground filling in

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[2] History of Agriculture (short essay), Rice University, http://schoolscience.rice.edu/duker/garden/gardenhis.html

spaces of the soil and rock. This groundwater reserve is called an aquifer.

SCENE 4

Over time people figured out where these aquifers were, drilled into them and built wells to pump the water out.

Since aquifers are often connected to surface water, wells can also reduce flows in nearby rivers and streams…

SCENE 5

Chapter 2: Water Imports (Problem)

In many places around the world, the human population has outgrown local water supplies from lakes, rivers, dams, and wells.

So how do communities with dwindling water supplies meet an ever-increasing demand? Many resort to importing water from remote areas and distant communities!

Importing water to our neighborhoods from far away places can be very energy intensive[4],

…especially when the water is pumped over mountains and through thousands of miles of pipeline and canals to its final destination[5].

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[3] About Dams, International Rivers, http://www.internationalrivers.org/en/node/287
[4] Energy Down the Drain: the Hidden Cost of California's Water Supply, NRDC, www.nrdc.org/water/conservation/edrain/contents.asp ;

It's only a matter of time before those far away rivers, lakes and aquifers dry up.

SCENE 6

Chapter 3: Increased Population (Problem)

An increasing population combined with changing rainfall patterns and our wasteful use of water is creating a global water crisis. Many people no longer have access to clean fresh water. In fact, today one in four rivers no longer flow to the ocean[6]. Our coastal salt water environments are suffering from this mis-management of dwindling fresh water resources[7].

We are reaching 'peak water[8],' the limits of our water supply.

SCENE 7

Chapter 5: Agriculture (problem)

Agriculture now accounts for over 70% of water use around the world[9]. And many agricultural practices have had tragic

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Water and Energy: Basic Information, US EPA, http://www.epa.gov/waterinfrastructure/basicinfo.htm

[5] California Department of Water Resources, State Water Project Overview

[6] Death of the World's Rivers and Rivers: A Drying Shame (truthout.org)

[7] The Economic Value of Estuaries, Restore America's Estuaries, https://www.estuaries.org/experts-say-us-coasts-and-estuaries-contribute-billions-to-economy-but-much-at-risk.html;
Estuaries and Your Coastal Watershed, US EPA, http://www.epa.gov/owow/oceans/factsheets/fact5.html

[8] Peak Water (pbs.org);
Peak Water (Wikipedia);
Peak Water by Meena Palaniappan and Peter H. Gleick

[9] Human Appropriation of the World's Fresh Water Supply (University of Michigan);

consequences.

When farmers over-irrigate their fields, some of the water soaks into the soil, while the rest runs off into nearby rivers and streams, along with fertilizer and deadly herbicides and pesticides[10]. These chemicals have helped increase the amount of food we can grow, but in the long run they are harmful to the soil, native fish, and wildlife, and can also soak into the ground to contaminate the groundwater below, making them harmful to us, too.

SCENE 8

Chapter 6: Wetland Destruction (problem)

Once considered worthless 'swamps,' wetlands are the filters of the ecosystem, removing pollution, reducing flood damage, and helping the water soak into the ground for our use later[11]. However, we have paved over many of our wetlands.

In the US, more than 50% of coastal wetlands are now gone[12].In Louisiana, loss of wetlands and the buffer they provided against storms has left our coasts more vulnerable[13]. If the development of

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Managing our Future Water Needs for Agriculture, Industry, Human Health and the Environment (World Economic Forum); Watering Scarcity: Private Investment Opportunities in Agricultural Water Use Efficiency (World Resources Institute)

[10] Agriculture and Pollution, US EPA, http://www.epa.gov/nps/facts/point6.htm

[11] Wetlands (U.S. EPA)

[12] Wetlands, Status and Trends (U.S. EPA)

[13] Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA):

these areas had kept natural processes in mind, the damage would have been much less.

SCENE 9

Urban development not only pollutes our rivers and oceans, it can also reduce our water supply. Because paved areas flush most of the rainfall off the land, very little is able to soak into the ground to recharge aquifers.

As the demand for water increases, the water in underground aquifers decreases.

SCENE 10

In the U.S. alone, we are using groundwater 4 times faster than it can be replaced[14].

In coastal areas, there's a fine balance between freshwater and saltwater below the surface. As freshwater from the aquifer is overdrawn with limited opportunity for recharge, seawater moves into

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A Response to Louisiana's Land Loss (Report by the Louisiana Coastal Wetlands Conservation and Restoration Task Force)

[14] Ground-Water Depletion Across the Nation and Ground-water depletion (USGS)

the void and take its place[15]. This saltwater intrusion[16] can devastate an aquifer, rendering it useless as a source of freshwater. And the problem is only getting worse as our climate changes and sea levels rise[17].

SCENE 10

Chapter 7: Urban Development Creates Urban Runoff (problem)

As urban areas grow, we have more roofs, streets, and pavement.

Instead of the rainwater soaking into the soil….

the water now runs over these surfaces, picking up pollutants in its path as it races into storm drains that empty into the rivers and oceans. And as more area is paved over, the ever-increasing volume of water floods neighborhoods and those living downstream[18].
With increased flooding, creeks and rivers are paved over to stop erosion, creating a concrete channel that moves the water even faster off the land.

SCENE 11

Chapter 8: Urban Development Creates Sewage (problem)

As population grows, urban development increases….which in turn increases the amount of water that goes down the drain.

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[15] Scientific Papers, SCitation, http://scitation.aip.org/vsearch/servlet/VerityServlet?KEY=FREESR&search=Search&smode=results&possible1=Salt%20water%20intrusion&possible1zone=article&bool1=and
[16] Saltwater Intrusion (Wikipedia);
[17] Rising Sea Level (State of Washington, Department of Ecology)

Traditional sewer systems collect all the 'wastewater' from our homes and offices and send it to a centralized treatment plant.

After residents, (PAUSE) businesses, (PAUSE) and industry

have used the water—often only once—

it's treated and released into the ocean or other nearby lakes and streams.

SCENE 12

And many cities are struggling with the dual-problem of stricter regulations to decrease water pollution and an ever-increasing volume of wastewater.

These centralized wastewater treatment plants use lots of energy to partially clean up the huge volumes of water we send down our drains, only to waste it by dumping it into the ocean[19].

SCENE 13

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[18] Effects of Urban Development on Floods, USGS, http://pubs.usgs.gov/fs/fs07603/
[19] "It's Time to Start Drinking Toilet Water", Slate, http://www.slate.com/id/2182758/

Chapter 9: Current Water Management (problem)

In California about 20% of the State's total energy demand is spent moving, treating, delivering, using and discharging water[20]. Despite the massive amounts of energy used moving water around, California still finds itself in a "water crisis." And California is not alone.

Water management is often the duty of at least five separate agencies:

…water supply, groundwater, flood control, water quality and wastewater (or 'sewage'). The choices made by one agency can impact the challenges of another. For example, when flood control engineers design systems to channel rainwater off the land, this wastes the water the supply guys need and creates a pollution problem that the water quality guys have to deal with.

SCENE 14

This disjointed water management …

…creates an unnecessary waste of energy -- contributing to climate change. And the crazy thing is, we end up with less water.

To top it all off, some folks want to pump salt water out of the ocean to desalinate it for use in our homes and businesses[21], when we just got through dumping fresh water into the ocean that we already

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[20] See California Energy Commission (CEC), 2005 Integrated Energy Policy Report, CEC-100-2005-007CMF, Sacramento, November 2005, pg. 150; CEC, *California's Water-Energy Relationship*, Final Staff Report prepared in support of IEPR-2005, CEC-700--2005-011-SF, Sacramento, November 2005; and Wolff, G. and Wilkinson, R., *Statewide Assessment of Water-Related Energy Use*, The Pacific Institute and The Water Policy Program at UCSB, prepared for the CEC PIER Program, draft report dated June 2006, pg. 8.

[21] Desalination: With a Grain of Salt, Pacific Institute, http://www.pacinst.org/reports/desalination/index.htm ;

bought and paid for! Ocean desalination is being considered all around the country – over 20 desalination factories are planned for the California coastline alone! [22]

SCENE 15

Think about it. We've done everything in our power to force much-needed water off the land and, now our water managers want to pump that water back out of the ocean to remove the salt – killing fish in the process and wasting tons of energy.

We're left with an un-coordinated, poorly managed, wasteful, polluting water system.

That's the cycle of insanity!

There must be a better way...

Solutions via Integrated Water Management

SCENE 16

Introduction

By rethinking how we manage and use our water, we can begin to solve many of these problems. We've all learned about reducing, reusing, and recycling our trash. We need to learn to apply these 3 R's *to all of* our resources, especially water.

The water supply guys use the term "integrated water management." But like we said – they're only concerned with water supply and not

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Seawater Desalination Issue Summary (Surfrider Foundation)

[22] Seawater Desalination and the California Coastal Act (California Coastal Commission)

the big picture. True “integrated water management” means holistic reform that integrates multiple agencies and members of the public -- and solves multiple problems beyond just meeting our ever-increasing water demands.

SCENE 17

Chapter 10 – Residential Conservation

If we take a closer look at how we use water at home, there are many opportunities to conserve and minimize our own ‘water footprint’.

First of all, we can Reduce our water consumption with low flow showerheads, modern clothes washers, and other smart appliances.

SCENE 18

Although our sewer systems are designed to process human waste, we put many other things down our sewer lines, like kitchen scraps, cleaners, drugs and other chemicals which can get into our rivers and ocean, harming fish and other aquatic life[23]. We should think before we use our drains for waste disposal.

SCENE 19

Chapter 11 – Ocean Friendly Gardens

In many homes, more than half of the water used goes to maintain a big green lawn[24], wasting water that we could drink or leave in place for fish and other wildlife.

Plants adapted to our regions' climate and soil require a lot less water and maintenance. Replacing a part of our lawn with native plants can save up to half of our household water use[25].

SCENE 20

An 'Ocean Friendly Garden[26]' conserves water AND reduces polluted runoff—helping to reduce flooding and keep pollution out of our creeks and coastal waters while giving you a beautiful garden full of new wildlife – a really fun alternative to boring grass. By contouring the land, adding dry creeks or seasonal ponds, and using permeable solutions for our walkways and driveways, runoff can soak into the soil to recharge local aquifers[27].

SCENE 21

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[23] Emerging Contaminants in the Environment, USGS, http://toxics.usgs.gov/regional/emc/

[24] Residential Weather-Based Irrigation Scheduling: Evidence from the Irvine "ET Controller" Study (Irvine Ranch Water District);
Residential Water Use Explained (savebuylive.com);
Residential Irrigation Water Use in Central Florida (ASCE)

[25] Saving Water by Going Native (usewaterwisely.com);
Water Wise Landscaping (bewaterwise.com)

[26] Ocean Friendly Gardens (Surfrider Foundation)

[27] Managing Wet Weather with Green Infrastructure, U.S. EPA, http://cfpub.epa.gov/npdes/Greeninfrastructure/Technology.cfm

We can also capture rain from our gutter with a simple rain barrel or slightly more complicated cisterns - and keep it for Reuse later[28].

Much of the water that we use inside our homes can also be reused on our gardens. Called “Greywater,” this is slowly being accepted as a great way to reuse the water from your clothes washer or bathtub to water the plants in your garden

Reusing our slightly used water in this way not only helps Reduce our water demand[29]…but it also reduces the amount of water we send to the wastewater treatment plant every day[30]!

SCENE 22

Chapter 12: Low Impact Development

These basic ideas can be applied on a larger scale, within our neighborhood or our entire city. Think of the benefits reaped by entire neighborhoods that reduce water use, capture rainwater, AND eliminate water pollution!

We can redesign our communities to capture rain close to the source, to filter back into the ground like the natural water cycle, or to store it

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[28] Id.
[29] Greywater Action, http://greywateraction.org/ ;
[30] Safe Use of Household Greywater, New Mexico State University, http://aces.nmsu.edu/pubs/_m/m-106.html

for reuse during dry times[31].

SCENE 23

The streets in our neighborhood can be landscaped with contoured ditches known as 'bioswales[32].' These capture street runoff so trees and plants can use and filter the water. Where space is limited, large underground cisterns can collect stormwater for later use. Pervious pavement can filter rainwater through parking lots reducing runoff.

Known as "low impact development[33]," it's rapidly catching on in areas along sensitive rivers and coasts including Oregon, Chicago, Florida, and Rhode Island. Low impact development can transform the landscape from one that sheds water— causing flooding and water pollution—back to a more natural state that captures and absorbs water, using it where it falls…

SCENE 24

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[31] Managing Wet Weather with Green Infrastructure, U.S. EPA, http://cfpub.epa.gov/npdes/Greeninfrastructure/Technology.cfm

[32] Bioswale (Wikipedia);
Bioswale (Dam Nation: *Dispatches from the Water Underground*. Ed. Woelfle-Erskine Cleo, et al. 2007. Soft Skull Press: Brooklyn, New York)

[33] Low Impact Development (Surfrider Foundation);
Low Impact Development (Johnson, Karen E. and Jeff Loux. Water and Land Use. Solano Press Books. 2004)

From ocean-friendly gardens to green streets[34], all of these ideas catch rain water where it falls for later re-use, so very little energy is needed to move it around. And, these simple steps reduce unwanted runoff – allowing us to restore the natural rivers and wetlands system in our communities.

SCENE 25

Chapter 13: Wastewater Treatment

Today's large industrial sewage plants collect huge volumes of water from an entire city, and pump it all to a single location for treatment, where it is discharged into the nearest body of water; which in coastal communities is the ocean. This huge volume of water includes sewage, grey water, and stormwater runoff, not to mention viruses, chemicals, and nutrients that weren't totally removed during treatment. This affects marine life and the water quality at our beaches. And think about this: with rising sea levels, coastal treatment plants may soon be under water – what are we gonna do then[35]?

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[34] LID Center – Green Streets;
BASF Admixtures' Pervious Concrete.
http://www.simplygreenbuilt.com/basf_admixtures_pervious_concrete.html
(accessed June 21, 2008).

[35] Strategies for Adaption to Sea Level Rise (U.S. EPA);
California Climate Adaptation Strategy, CA Resources Agency,
http://www.climatechange.ca.gov/adaptation/

SCENE 26

The first step in solving this problem is to reduce our own waste. Household conservation and greywater use can significantly reduce…

…the actual volume of wastewater ending up at the treatment plant every day.
And it's not just water that we waste. The food scraps we toss down the disposal are mixed with sewage and sent to the Wastewater Treatment Plants, where they are separated and disposed of.

SCENE 27

Many cities have to transport all this solid waste hundreds of miles away for disposal.

By composting our kitchen waste at home, we can help reduce the amount of waste that gets trucked away.

Many treatment plants can generate energy from solid waste. And new technologies may make it possible to generate enough to operate the plant as well as provide a local source of biofuel[36].

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[36] Electricity Generation From Anaerobic Wastewater Treatment in Microbial Fuel Cells (U.S. EPA)

SCENE 28

Chapter 14: Creating a Local Water Supply

If we re-think how we transport and process wastewater, new opportunities arise. Many cities are now reclaiming wastewater (that's right, sewage!) for reuse in our homes and businesses, or for direct recharge of aquifers[37]. One of the best opportunities for wastewater is recycling it to drinking standards.

SCENE 29

"Potable Reuse" is the process of purifying our wastewater to make it drinkable. Wastewater from homes and businesses is forced through very fine filters, allowing water molecules through while trapping dissolved salts and other impurities. Potable Reuse is an efficient source of water because it makes use of water that is already in our local water system. And it is also good for the environment because takes impurities out of the system, eliminating the need to discharge polluted wastewater into the ocean. Communities around the country are already drinking it as part of their normal water supply[38].

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[37] Groundwater Replenishment System;
Orange County Water District. Groundwater Replenishment System. Facts and Figures. Available at: http://www.gwrsystem.com/about/facts.html (accessed July 27, 2008).

SCENE 30

Some coastal communities have latched onto the idea of desalinating ocean water to make it drinkable. A desalination plant sucks up water from the ocean through massive intake pipes, where it undergoes a very similar filtration process as Potable Reuse.

However, seawater desalination uses huge amounts of electricity… often even more energy than importing fresh water from elsewhere. That's right; it takes *more energy* to remove salt from seawater than it does to transport it through hundreds of miles of pipes and canals, over mountains, and through valleys to your faucet[39].

SCENE 31

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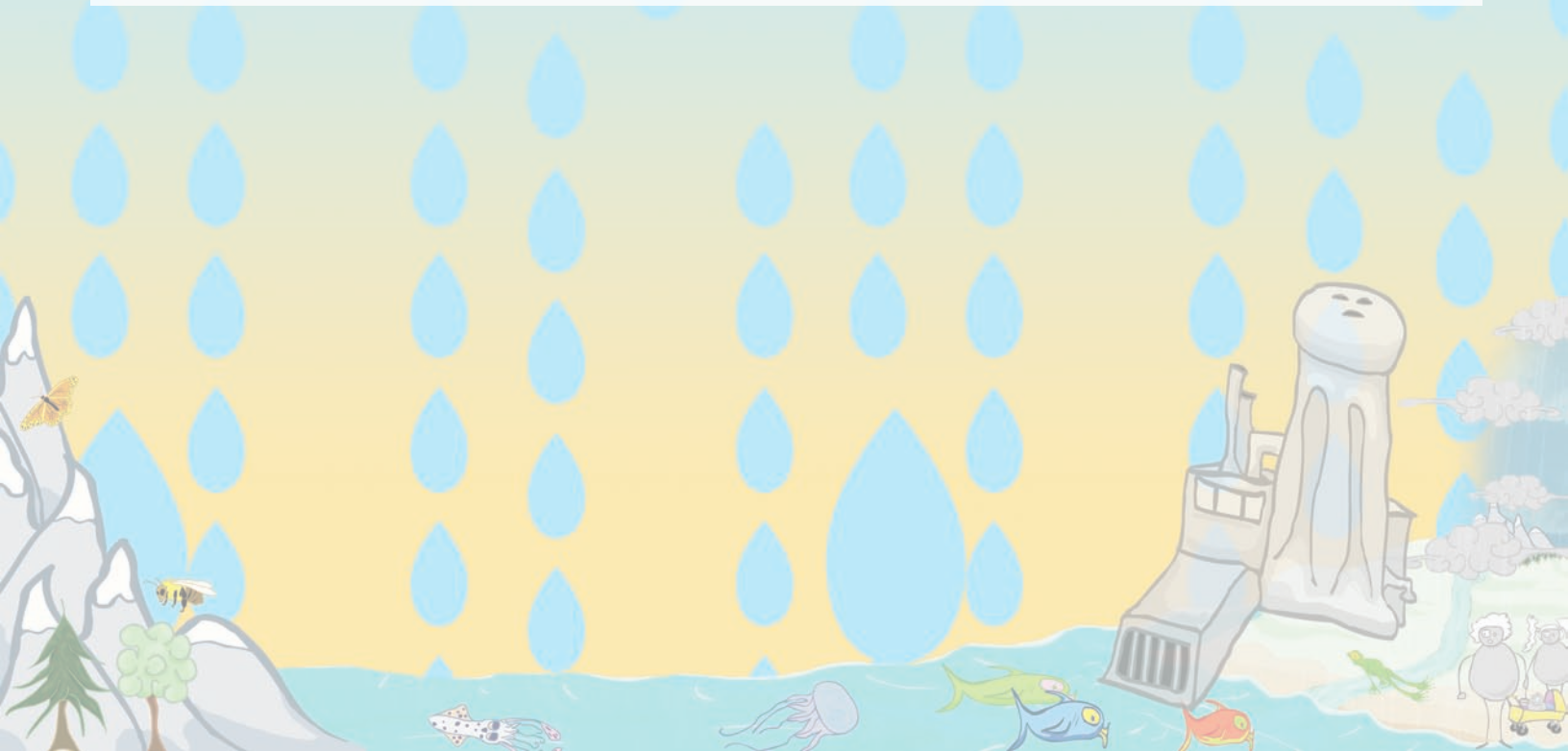
[38] Toward Sustainable Water Systems: *Potable Reuse of Wastewater* (Melon Wedick)
[39] Seawater Desalination and the California Coastal Act (California Coastal Commission); Desalination: With a Grain of Salt, Pacific Institute, http://www.pacinst.org/reports/desalination/index.htm



Moreover, the vast majority of proposed desalination plants would suck up and kill surrounding marine life[40]. And for all the energy used and fish killed in the process, *less than half of the water is drinkable*.

On the other hand, treating wastewater so it can be reused for consumption requires a fraction of the energy of desalination, and has positive, rather than negative impacts, on water quality and local aquatic habitat.

And it's cheaper!

SCENE 32

If we create smaller scale, more local wastewater treatment plants which purify water so it's safe to drink, it will allow us to Reuse our most important resource, Reduce energy demand and climate change, and it will also dramatically reduce the volume of pollutants we discharge into our rivers and beaches.

SCENE 33

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[40] Seawater Desalination Issue Summary (Surfrider Foundation); Living in the Environment. 10th Edition. Miller Jr., G. Tyler 1998

Chapter 15: Conclusion

Now is the time for a water management system that integrates the 3R's-reduce, reuse, recycle - to address our water crisis AND help reverse the damage caused by our current mismanaged system.

This truly integrated water management program creates a holistic solution that incorporates ocean friendly gardens and low impact development to reduce our impact on the water supply. Gray water systems encourage the reuse of our precious water resources. And potable reuse recycles the water we've already paid for and transported.

We have the unique opportunity to transform water management and meet our current and future needs with science and tech that is proven to work. Residents, businesses, and government agencies must all work together--to seize this opportunity and change our water habits before it's too late.

ALT ENDING

Here’s what it all comes down to. The unique opportunity to transform water management to meet our current and future needs is in our hands. The ideas and systems to make this happen already exist. If we keep conscious of the three R's – reduce, reuse, and recycle – we truly can achieve integrated water management. Think about it...a holistic system that incorporates ocean friendly gardens and low impact development which will REDUCE our impact on the water supply...using gray water systems and rain barrels to encourage the

REUSE of our precious water resources... and employing innovative ideas like potable reuse to RECYCLE the water we've already paid for and transported....Simply by working together – residents, businesses, and government agencies – we can address our water crisis and help heal the damage caused by the current mismanaged system. .You can start today.